The „golden rice“ - a big illusion?

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A team around Ingo Potrykus from the Swiss Federal Institute of Technology in Zuerich, constructed a transgenic rice containing Provitamin A. 3 gene-constructs were inserted into the rice genom which complete the biochemical pathway needed for vitamin-A production in the rice grain. The work has been funded by the Rockefeller Institute (USA) and the European Union.

Vitamin-A deficiency is known to cause partial or full blindness (Xerophthalmia) and to exacerbate illnesses such as diarrhoe or measles in children. Vitamin-A deficiency (VAD) is associated with malnutrition and afflicts in the first place the very poor in Asia, Africa and Latin America. FAO and WHO estimate that about 250 million people (mainly small children and pregnant women) are threatened by VAD. „We can help these people in the future“, says Ingo Potrykus, and he and his collegues are determined to give the transgenic rice free of charge and any restrictions to „the poor farmers in developing countries“. His study appeared in the journal Science on 14 January 2000 (p. 303); Science sent a preprint of the article to 1700 journalists around the world and Mary Lou Guerinot, who wrote the commentary in Science, remarks:“One can only hope that this application of plant genetic engineering to ameliorate human misery without regard to short-term profit will restore this technology to political acceptability.“

Plans to reduce VAD emerged on a global scale following the World Summit for Children (1990) and then the World Food Summit (1996).

One of the most comprehensive interventions was the international 10-year-project UN and FAO started together in 1985.

3 strategies were used to fight VAD:

1. *Food-fortification* (e.g margarine containing vitamin-A in the Phillipines; sugar fortified with vitamin-A in some Latin American countries).
2. *Administration of high dose vitamin-A capsules* twice a year and
3. *Food-based projects* or dietary approaches. Vitamin-A is found in meat, fish, eggs or milk-products. Provitamin-A is found in plants, especially in green leafy vegetables and fruit.

In most countries the first 2 strategies have priority. They are easy to administer and show fast results. The 3. strategy, though complexer, was neglected for a long time, but it is becoming increasingly important.

Here some examples of food-based projects:

In ***Bangladesh*** there is a very high prevalence of VAD. FAO started a food-based project (concentrating on home-gardens) in 1993, together with Helen Keller International (HKI) and 14 NGOs: The introduction of small home-gardens with vitamin-rich vegetables and fruits, the taking up and improvement of traditional cultivation methods, discussion-rounds, education programms etc. Families without any land were helped to grow vines up the sides of their houses and plant beans, pumkins and bottle-gourds in the vines - all of which have commonly eaten leaves. Women, having experienced health- improvements of their children, started to work for the project, a spread like a snowball-system. From the very beginning the projects were integrated in the communities and supported by NGOs. In the meantime around 600’000 households (or over 3 million persons) are part of the project. The project was accompanied scientifically by UN and the HKI. Of course there were also drawbacks, but MW Bloem and his team from HKI could show: 1. The health condition improved. 2. Only small plots of land are needed to provide sufficient vitamin A. 3. A surprising result was: The more *different* fruits and vegetables a person eats, the better is the uptake of provitamin A. An *increase in number of varieties* seemed to bring significant improvement, independent from the quantity of food eaten (possible reasons: better bioavailability, synergy-effects). 3. Families with scattered gardens most often plant the biggest variety of fruits and

vegetables and had a better uptake of provitamin A. These are mainly the very poor families (who cannot afford an own home-garden.)

In ***Thailand*** the „door opener" for a food-based project was the vitamin-A rich, green leafy vegetable ivy gourd (Smitasiri, 1992). Ivy gourd is cultivated with relative ease and grows wild in many communities. The 3-year-project ('88-'91) consisted of a collaborative approach, rather than „top-down", and put much weight on social marketing, developping many innovative and low-cost-approaches: Radiobroadcasts (involving 8 main-channels), posters, comics and T-shirts with the ivy gourd, video and cassette tapes. Mothers, school-teachers, health- and agricultural-workers were participating as well as Buddhist monks. A prominent monk made a taping to encourage people to support the project. Theater-groups and puppet-shows involved the kids. Well known folk-singers produced tapes which incorporated the ivy gourd's value. Regular monitoring and a yearly collection and evaluation of all informations helped to implement new and/or corrective activities and evaluate the effectiveness.

In ***Mali, Burkina Faso, Niger*** and many other African countries the seasons are usually very short. Drying of nutrient fruits and vegetables has tradition, and low-cost solar drying techniques can garantee a minimal loss of provitamin A during the drying-process. Dried mangoslices will retain high levels of provitamin A activities for as long as 6 months.

In the final FAO report of the 10-year-project there is consensus that the food-based approach, though widely spread, needs much enhancement.

John R. Lupien, director of the „Food and Nutrition Division" of FAO in Rome, concludes: „A single nutrient approach towards a nutrition-related public health problem is usually, with the exception of perhaps iodine or selenium deficiencies, neither feasible nor desirable." Even more clearly is the statement of Franz Simmersbach, FAO. "It is as if Vitamin-A research makes researchers blind!", and adds: „Unless you give priority to operational field work, research and programmes related to food and nutrition education, the children we identified as being in need will not profit from all of this in time." (Final Summary Report, FAO, 1996)

Bruno de Benoist, from WHO in Geneva, is convinced that a holistic approach, including both food-fortification (for a first imput) and dietary approaches are necessary. He and others believe, that maybe the vitamin-A rice could be an additional help, among many other approaches.

Barbara Underwood, one of the leading experts of VAD, pledges for a new paradigma:"The current usual paradigma of food, nutrition and health institutions must change from a vertical approach to a holistic, flexible system approach that includes empowering communities to be involved, as well as monitoring and adjusting the system to the dynamics of local changes." She adds:„Lessons learned from successful interventions in developing countries indicate that sustainable solutions are attainable only if all stakeholders are successfully engaged in partnerships that include the poor."

Many successes have already been achieved. Donald McLaren from the International Center of Eye Health, London, and an expert of VAD since the late sixties, remarks that great progress has been made in this area: „For example, the number of young children with xerophthalmia has fallen by about two-thirds in the past 20 years." Bruno de Benoist from WHO in Geneva is a little more carefull. He confirms, that in some countries (such as Indonesia, India or Bangladesh) the number of afflicted children has dropped significantly, although exact trends are hard to predict because of lacking figures. And according to the World Bank, investments in all 3 programmes to prevent vitamin-A deficiency are among the most cost-effectives of interventions to improve health. (Example: The above mentioned, 3 year project in Thailand to promote production and consumption of vitamin-A rich foods was estimated to have a per-capita cost of US$0,42; see FAO and ILSI Guide, 1997)

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Besides being an isolated and single nutrient approach the project of the transgenic rice raises other doubts as well:

1. Biology

The provitamin-A rice only exist in a laboratory. There is no experience if the plant also survives in different eco-systems (it is a common observation that transgenic plants, performing well in laboratories, fail in nature, specially if they contain not one, but 3 added gene-constructs). Furthermore the uptake of provitamin-A depends on many factors. Provitamin A has to be absorbed by the guts and then built up to vitamin A in the body. This only functions in the presence of fat or oil, because provitamin A is only fat-soluble. Poor people's diet is often missing fat; they then would excrede the provitamin-A undigested. Worm infections or diarrhoes can lead to vitamin-A deficiency. According to Bruno de Benoist from WHO bad hygienic conditions and dirty water are important factors of VAD.

The bioavailability of provitamin A is still poorly understood (eg. carrots produce provitamin A in a hardly digestable crystal-form; they should be cooked, and some oil added, to allow the uptake. From oranges the provitamin-A absorption is much easier). Furthermore, evidence is growing that malnutrition with health consequences often also extends to iodine, iron (the main factors), and to vitamins C and D, folate, riboflavin, selenium and calcium. „There is no 'quick fix' or 'magic bullet' solution.", remarks JohnR.Lupien from FAO.

2. Patents

Ingo Potrykus plans on making the transgenic rice available to poor farmers for free, without any patent-claims. He even publicly denounced patenting: "So many fields of research are blocked by corporate patents. I had to ignore them or I couldn't move at all." Scientists should start now by simply breaking the law, he says."What company wants the negative publicity of putting me in jail for fighting poverty?" (The Progressive Populist, St.Louis,1999).

But there is another Ingo Potrykus: In former times he used to work at the FMI (a Novartis-daughter), and he still has very close connections to this company. A database-research revealed that Ingo Potrykus is named as „*inventor*" on *30 plant-related patents, most of them belonging to Novartis*. In 1992 „No patents on Life!" Switzerland filed opposition to patent No EP 0164575:"Direct transformation of genes into plant hereditary material". One of the inventors is Ingo Potrykus; the patent belongs to Ciba-Geigy, now Novartis. The latest Novartis-patent with Potrykus as inventor was issued in February 1999 (No US 5976880). Furthermore Potrykus admits himself that they filed a patent-application for the transgenic rice („before others do it") and that his group used some patented processes to construct the rice (possibly with himself as inventor). And Novartis may well promise to give up all claims. Novartis plans to merge its agro-division in 2000 with the Swedish-British company AstraZeneca to create the new Agro-giant Syngenta. Does this Swedish-British-Swiss Company also give up all patent-claims? Say, in 7 years, when Thai-farmers want to use it in their crops?

3. Culture

The transgenic provitamin-A rice has a deep yellow colour. But for decades Southern people „learned" that „whiter than white" (for bread and rice) was a symbol for progress, quality and Western superiority. Now, all at once, it's the yellow colour they should prefer. FAOs experiences with VAD-programs show that a key to any success of such programs is a careful appreciation of cultural habits, traditions and beliefs. They cannot be changed overnight.

The genetically engineered and patented 'golden rice': Once again we encounter the typical Northern attempt to solve the problems of the South with a technocratic „magic bullet" approach. But we know from the experience of the last 50 years that this kind of isolated and one-dimensional approach hardly ever works.

Main sources:

Collection of some relevant articles: www.blauen-institut.ch (see 'topics', then 'Vitamin-A-documents')

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